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REPORT OF THE DIRECTOR

For the Year Ending
October 31, 1931

Connecticut
Agricultural Experiment Station
New Haven

CONNECTICUT AGRICULTURAL EXPERIMENT STATION

As of October 31, 1931

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REPORT OF THE DIRECTOR

For the Year Ending October 31, 1931

To the Board of Control of the Connecticut Agricultural Experiment Station:

For some years it has been customary to publish a brief review of the Station year under the title *Report of the Director.* No attempt is made to include all activities, only those of most general interest being chosen. The material here presented has been prepared by the Station Editor, based on reports furnished by the several departments. A complete list of projects will be found on page 488.

Although the effects of falling prices of farm products were not felt in Southern New England as early as in some other parts of the country, Connecticut farmers are now facing problems more serious than for the past thirty years. Under such circumstances, efficient and intelligent management becomes increasingly important. Farmers look to the Station for technical information on every phase of their business, especially the protection of crops from the ravages of fungous and insect pests. It is imperative that scientific investigation does not lag behind the need, for at best, the learning of nature's laws is a slow process.

During the past year two events have influenced the Station profoundly. On November 6, 1931, occurred the death of our beloved Director Emeritus, Dr. Jenkins. For more than a half century his great talents and energy were devoted wholly to the Station and to the advancement of agriculture in the State. While this is not the proper place to publish an extended record of his life and work, it is fitting that there be reproduced here the tribute of the Station Staff.

WHEREAS, the distinguished career of our beloved friend and Director Emeritus, EDWARD HOPKINS JENKINS, was suddenly ended by death on November 6, bringing sorrow and a deep sense of personal loss to all of his associates on the Station Staff, particularly to those who had served with him for many years, and

WHEREAS, he contributed conspicuously to the advancement of scientific agriculture and to the general welfare of mankind by his personal studies, his writings, his skill in inspiring and directing the scientific work of others, and by his marked administrative ability; and

WHEREAS, in him the attributes of the scholar, the administrator and the public servant were so admirably supplemented by the rare qualities of mind and heart of the man, therefore be it

Resolved: That we, his friends and colleagues on the Station Staff, record our lasting pride in his varied and outstanding public service to his State and Nation; our admiration of his steadfastness in fostering sound principles in scientific thought and investigation; our appreciation of his exemplary courage, cheerfulness, modesty and human kindness; and finally, and above all, our affection for the man himself because of his sympathy and wisdom as a counsellor, and his loyalty and devotion as a friend.

For the past ten years the problem of overcrowding in the laboratory has been a matter of serious concern to the Board and Staff. An item for a new building was included in the estimates presented to the General Assembly of 1929 but no action was taken. However, the Assembly of 1931 appropriated $25,000, which, with funds from other sources, made it possible to proceed with our plans. Some years ago the Board decided that this building should be a memorial to Dr. Jenkins and accordingly it will be called Jenkins Laboratory. Dr. Jenkins did not live to see the construction begin but took great interest in the development of the plans.

W. L. Slate,

Director.

Apples Found Free of Harmful Amounts of Spray Residue

A chemical analysis of apples grown last summer in Connecticut showed the crop to be free of harmful amounts of the arsenate of lead applied in sprays, which confirms the general experience of growers in this state. Suspected fruit has been analyzed in several cases in years past, but spray residue in objectionable quantity was never found.

It has become an established practice in this country to spray fruits and vegetables in order to control insect pests and plant diseases. If poisonous materials carry over to the marketable product, the health of the consumer may be affected. In the last 10 years both growers and food control officials have given increased attention to the problem of spray residues and all have cooperated in an effort to safeguard the consumer. Some parts of the United States have had considerable trouble in exporting apples because the fruit had a spray residue as a result of the heavy applications needed to control the codling moth, and the infrequency of rains that might wash off the spray.

Food and drug officials in the United States have agreed that .01 grain of arsenic to a pound of fruit is harmless to the consumer, but for the present a slightly more liberal tolerance (.012 grain) is recognized administratively. Exporters must meet the standard of .01 grain, known as the world or international tolerance, which eventually will be observed in this country.

The amount of arsenic on the Connecticut samples analyzed was far below .012 grain to the pound, the nearest approach being about half of the accepted limit. Excluding this one instance the range was from .0007 to .0037 grain to the pound of fruit. For the analysis 19 samples were collected from trees, sorting tables, and boxes packed for the market. They came from various localities in the state. All were selected as examples that showed the most noticeable amounts of residue, and it was noted what proportion of the crop was formed by these apples that showed spray residue.

When the analyses were announced, growers were warned that although such favorable results were shown, no one should be complacent or indifferent to the problem. Unusual conditions may occur when the fruit will have extra amounts of spray residue, and it was suggested that such emergencies be prepared for.

Food Products Tested

A survey of so-called soft drinks, which was made as a part of the annual inspection of foods and drugs sold in this state, shows that violations of the law relating to the composition and

labeling of carbonated beverages are rare. There appears to be an increasing number of beverages containing caffeine. Coca Cola, Pepsi Cola, O. C. Cola and Braser are products of this type. They contain caffeine in approximately the proportions found in tea as ordinarily prepared for the table.

Examination of 785 samples of market milk showed again that milk dispensed in restaurants, by the glass, rather than by the bottle, is likely to be variable in quantity and frequently below standard. Almost half of the samples submitted were found adulterated or otherwise below standard. This cannot be interpreted, however, as representing the general character of the milk supply in the state because samples for the most part were taken on suspicion of adulteration or inferiority.

The large proportion of skimmed milk may be explained by the fact that many samples were taken where milk was being dispensed by dipping, or pouring from quart bottles, rather than from individual service bottles. This practice is contrary to law, which requires that milk when ordered in any hotel, restaurant, or lunch room, shall be served in the original bottle, the cap of which shall not be removed except in the presence of the patron.

Other items of food products examined included eggs, foods used for special diet purposes, and salad dressings of the mayonnaise type. More than 200 samples of drugs, chiefly United States Pharmacopoeia and National Formulary products, were examined, of which 73 did not fully meet official specifications.

New Labeling of Fertilizers Announced

New practices in labeling fertilizers were announced July 1 by the Station, to be effective January 1, 1932. The regulations provide that the nitrogen content of fertilizers must be stated in terms of nitrogen, not in terms of ammonia, as formerly. Furthermore, the percentages of items of plant food must be stated in whole numbers and in the following order: (1) nitrogen, (2) phosphoric acid, and (3) potash. The grade must be included as part of the brand name, for instance, "Potato Manure 4-8-4."

As a result of several conferences held during the summer, uniform regulations have been adopted in all of the New England states and in Delaware, New Jersey, and New York.

More than 1,000 samples of fertilizer and fertilizer materials were analyzed last year. Of the so-called "complete" fertilizers, that is, those supplying nitrogen, phosphoric acid, and potash, about 25 per cent of the samples examined failed to meet guaranties in all of the items of plant food nutrition, but on the basis of total guarantees 90 per cent were met or exceeded. The difference between these two ratings is due to the fact that most of the

deficient samples fell below guarantee in one item, but met or exceeded it in the other two. The estimated commercial value of deficiencies exceeded $1.00 a ton in only 3 out of every 100 samples examined.

Nutritive Properties Found in Tobacco Seed

Chemical investigations on tobacco seed developed an unexpected picture of proteins and fat, both of which are being subjected to further study. To test the possible nutritive quality of these, a complete series of feeding experiments on rats was conducted. On a diet of 98 per cent tobacco seed, 2 per cent mineral salts, and

FIGURE 33. Female rat and five young reared on tobacco seed.

10 drops of codliver oil daily, rats have been reared to maturity and have reproduced not only one generation, but even a second, of normal offspring. It would seem that tobacco seed contains adequate proteins and fats and sufficient quantities of vitamins B and E. It is deficient in vitamins A and D and also probably in certain inorganic salts. Similar experiments on pigeons have been successful, and will be tried on chickens.

Protein Chemistry

A series of analyses of the insoluble proteins of protective animal tissues, usually designated as keratins, has been carried out. The tissues studied include human hair, wool, feathers, and snake

epidermis. In addition silk fibroin and the horn-like skeleton of two species of coral were examined. As a result of these studies it has been possible to add an important modification to the definition of this interesting and important type of protein in which, for the first time, an attempt is made to define a class of proteins in terms of their amino acid composition.

Investigations of individual amino acids have been continued and some of the results are in process of publication. The most important of these is the crystallization of ornithine, which was accomplished for the first time.

An extensive historical review of the discovery of the protein amino acids has been compiled in collaboration with Prof. C. L. A. Schmidt of the University of California.

Chemistry of the Tobacco Plant

The tobacco plant has continued to furnish a most fruitful field for biochemical research. A preliminary study of the organic acids of the fresh and of the cured leaf has been completed and is described in Bulletin 323. Modifications of the existing methods for dealing with these substances were devised and results of quantitative significance were secured. It was found that only about half the total titratable acidity of the tobacco leaf extract consists of acids of familiar types such as malic, citric, oxalic, succinic, and fumaric acids. The rest belongs to acidic substances the nature of which is yet to be determined. It was shown that the indirect methods commonly employed for the determination of the organic acids in tobacco do not yield trustworthy results.

The chemical changes involved in the curing of tobacco are not only important in that they affect the quality of the cured leaf, but they also offer an especially good subject for chemical investigations. A most interesting series of studies is reported in Bulletin 324, "Chemical Changes that Occur During the Curing of Tobacco." One would assume that the leaf loses water during curing, but there are other losses and changes of far greater importance. Nearly 20 per cent of the total solids disappear during curing. Of the total nitrogen, there was an actual loss of 14.6 per cent. Only a very small part of this could be accounted for as the evaporation of nicotine, most of this nitrogen loss probably being a direct loss of ammonia from the cells.

As a by-product of these studies, an explanation has been supplied for the erratic results that are sometimes obtained in determinations of amide nitrogen in plant materials. It was found that the nitrate normally present in tobacco leaf reacts with the hydrochloric acid customarily employed for the hydrolysis of the amides, and with an easily oxidized substance of unknown nature

that is also present in fresh leaf tissue. The end product of this reaction is ammonia and, if the occurrence of the reaction were not detected, it would be assumed that this ammonia had its origin from amides in the leaf. This reaction is therefore an important source of error in the estimation of amide nitrogen. Means were found to avoid this error and the study of the reaction is to be continued.

Experiment Indicates Chestnut May Return

Field observations, together with experiments with 20-year old cultures of the chestnut blight indicate that the chestnut tree may some day blossom again on the hills of Connecticut.

This summer trees on the Station grounds were inoculated with cultures of the fungus that had been kept alive saprophytically for 20 years. In comparison trees were inoculated with cultures two years old or less. The results were that the trees treated with the 20-year old fungus failed to catch the disease, but the other chestnuts became infected.

If further experimentation confirms these results, it would seem that continued culture as a saprophyte causes the chestnut blight to lose its virulence. It is believed that the same thing may gradually happen in nature. The blight will soon have consumed most of its living material in this region. Thereby hope exists that the chestnut may come back again, as it did more than 100 years ago, following the mysterious disease that killed many trees in the South.

The Station botanists have found that all the old chestnut trees are either dead or dying of the blight. One old-timer, 24 inches in diameter, bore approximately only 150 living leaves last summer. The blight had killed all but a narrow streak of bark on the north side.

A few sprouts and seedlings, both infected and healthy, about 4 or 5 inches thick at the base and 30 feet high, were seen in the woods. Because of the disappearance of the old infected trees and the lesser number of infected sprouts, one or two surviving sprouts that have escaped the blight are occasionally found.

A fairly large number of seedling chestnuts under eight feet high are still in our woods. This year most of them were quite vigorous and often free from blight. These younger, more isolated, seedlings may carry the survival of the chestnut, because of the lessening opportunity for infection, and the possibility that the blight itself may gradually lose its virulence as a parasite.

The Station has never found a truly resistant tree or seedling in this state. All of the trees that have been reported either belonged to a different species or were survivors that finally died.

Control of Vegetable Diseases

The Station inaugurated a new series of experiments in the control of vegetable diseases, and plots were laid out at Mount Carmel for the observation and treatment of the vegetable crops commonly grown in Connecticut. The project is in charge of a Staff member who will specialize in this field.

As has been previously demonstrated, adequate spraying of potatoes resulted in a marked increase in yield, although there was no late blight in the field. The treatment with Bordeaux mixture

FIGURE 34. Dusting Cucumbers with Bordeaux dust on Station Farm.

prevented early blight, tip burn, leaf hopper and flea beetle injury and increased the yield from 35 to 50 per cent. Tubers from the sprayed plants were much larger than those from the untreated rows; only two-thirds as many potatoes from the sprayed plants were required to fill a bushel.

A higher concentration in the Bordeaux spray, 8-8-50 or 12-12-50, raised the yield 20 bushels to the acre. The standard formula is 4-4-50. Moreover, the sprays of greater strength gave better coverage, remained on the foliage longer, and preserved the plants in a green condition longer than the 4-4-50 treatment. High pressure spraying, that is, 400 pounds, was found more satisfactory than 150 pounds, in that with the high pressure the material was easily

and quickly applied and covered the plants better. However, the high pressures gave no increase in yield.

A comparison of Bordeaux dust with Bordeaux spray on potatoes showed the dust treatment to be much inferior to the spray in this region. Dusting increased the yield only 17 per cent as against 40 per cent for the spray. Tomatoes that were sprayed bore fruit for almost a month longer than plants dusted or untreated.

Disease free cabbage and cauliflower plants were set in the field on plots artificially inoculated with club root. The treatments and results were as follows:

No lime	100 per cent infection
1½ tons per acre hydrated lime	26 per cent infection
2½ tons per acre hydrated lime	16 per cent infection

Other investigators have shown that to control club root completely the soil reaction must be neutral, or give a reading of 7 pH. In these trials the unlimed soil tested 4.65 pH. One and one-half tons per acre of hydrated lime raised the reaction to 5.12 pH and two and a half tons to 6.18 pH. The results would indicate that more lime should have been added to obtain complete control. In other words a reaction of 7 pH is probably necessary to prevent development of club root.

A test on seedlings in infected soil was made in the greenhouse. On the limed section, only 15 per cent of the seedlings were diseased whereas on the unlimed section, 50 per cent of the plants showed club root.

Personal Service in Plant Diseases

More than 200 specimens of plant diseases and weeds that injured crops and gardens in 1931 were submitted by farmers and home-owners for identification. Station botanists examined them under the microscope and in cases where a control was known for the pest, these remedial measures were explained. The long growing season with more rain than in the preceding summers encouraged the spread of fungous diseases.

The examination of plant specimens constitutes an important personal service of the Station, for it places before the farmer the means to help him out of his plant disease troubles. In addition to these laboratory studies, staff members visit fields, gardens, and greenhouses, to observe conditions there. Constant watchfulness is maintained to prevent serious outbreaks, as in human epidemics.

Three fungous diseases never before seen in this state, were found this summer. One is an anthracnose of peas that occurred in Norfolk, caused by the fungus *Gloeosporium pisi.* It is similar to

the Ascochyta blight common on peas, but is more severe. The anthracnose shows on the leaves, pods and stems, and often reaches down to the roots. A weak growth is produced where the disease is abundant.

A black dry rot of radish was found on the Station farm in

FIGURE 35. Identification of specimens in the Station herbarium.

Mount Carmel. The third new fungus was a poplar leaf curl similar to the peach leaf curl. The disease occurred in two nurseries but was not severe.

Twelve fungi already known to Connecticut growers were found this summer growing on plants they had never attacked before. Among them were the common black rootrot of tobacco growing on two flowers, the lilac and peony. An unusual thing occurred

at Wethersfield when the potato blight, *Phytopthora infestans,* caused a rot on tomatoes. This has rarely been seen in this state since it was first recorded in 1889.

Favorable weather conditions the first of May developed an abundance of the willow scab fungus, which receded the year before. This disease is fatal to yellow twig willows, the variety most often found on roadsides and lawns, and is gradually killing such trees over the entire state. The severest outbreak is in Norfolk. The disease is also present in other New England states, New York and Canada.

Shade and forest trees were injured in all parts of the state. Oaks dropping their leaves was a common complaint. Study disclosed a curious story; much of the trouble was due to the dry weather of 1929 and the drought of 1930. Moisture, which in a normal season is stored in the soil where deep roots can reach it, was lacking in these two years, but the reserve soil supply did not fail until the summer of 1931. Then the trees showed drought symptoms and appeared unhealthy.

The lawn fungus that suddenly spread in epidemic fashion on home lawns and golf courses in 1930, appeared last summer in all parts of the state and caused more damage than before. Station botanists have never known such outbreaks as those that occurred last year and this. The grass is matted down as if it had been saturated with gasoline or kerosene and under the microscope the dead leaves show black spots. Prolonged periods of hot, wet weather encouraged the growth of the infection. On dry days there was little, if any, development of the disease. Lawns recently seeded appear to be most susceptible and bent grasses seem to be most severely injured. Bordeaux mixture will effect fair control in most instances. Damaged lawns should not be watered excessively; this causes the fungus to spread in a widening circle.

Tests Show Seed Labels Correct

Analyses of samples of unmixed agricultural seeds collected by the Commissioner of Agriculture under the recent state seed law showed that the labels in most cases truthfully stated the quality of the product. Not many samples were far from the claims made for them. Of the unmixed seeds, 284 official specimens were tested for both purity and germination. Sixteen lawn mixtures were examined for purity and some were found below the quality claimed for them. For private individuals, 220 germination tests and 13 purity tests were made.

Spray Warnings by Radio

Recommendations on when to spray orchards for the control of insect and fungous pests were furnished by the Station in co-operation with the extension service for radio broadcasts in the spring and summer. The weather was forecast on three synchronized stations, WBZ, Springfield, and WBZA and W1AZ, Boston, for the afternoon of the day the information was given, the next day, and when conditions permitted, for the third day. The spray warnings were supplementary to the weather forecasts. If there were danger of apple scab infection, or necessity for control measures against any other pests, the information was telegraphed to the broadcasting system. This plan, which was in effect for the first time last summer, was followed instead of the telephone spray service of previous years. The results were sufficiently promising to warrant further trial.

New Fungus on Willow

Preliminary inoculations have been obtained of a Septomyxa-like fungus that grew quickly and virulently on the cultivated golden weeping willow. Spores were produced in 12 days from this species. Infections of the weeping willow, *Salyx babylonica,* were weak, while the Lemley variety was not at all susceptible. The fungus has been found in Connecticut, but the material for study came from New York State.

Elm Fungus Destroying Trees

The elm fungus discovered in New Haven five years ago has been found in Ohio by Curtis May. It has been identified tentatively as Cephalosphorium. Our extensive inoculations revealed it as a weak parasite in comparison with the virulence of the Ohio strain, although our fungus was re-isolated from some of the inoculations. The two elms in New Haven from which the fungus was originally isolated have continued to grow worse and this summer were in a bad condition.

Eleven Million Parasites Distributed

For the second year since parasites were released throughout the state in the hope of controlling the Oriental peach moth, the peach crop has been grown and sold freer of worms. It is believed that the parasites have been effective in combating one of the most

costly insect pests of recent years. Observers found that in orchards where parasitism was high, there were fewer peach moths, and where parasitism was low, more moths appeared.

Production of the *Trichogramma minuta,* a parasite that destroys the peach moth egg, last summer was 11,500,000, or twice the number bred in 1930. Ten thousand specimens of the *Macrocentrus ancylivora* (a larval parasite) were distributed to the growers. Station entomologists in charge of the work believe that a maximum number of parasites was sent to the growers, in view of laboratory equipment and mailing facilities.

The Station has advised growers to reduce fertilizer or use any other treatment that will retard rank growth of the tree. The reason for this is that the peach moth larvae develop in rapidly growing shoots. This year the unusual warmth and heavy rainfall of July encouraged tremendous reproduction of the insects, which were conspicuously scarce in June, and favored the growth of young peach shoots, which furnished food for the larvae.

The 11,500,000 Trichogramma were reared in grain moth eggs provided by moths from an infestation in 24 bushels of wheat. These parasites were distributed in the eggs, which were glued to cardboard disks and mailed special delivery to the growers. The disks were then hung in the trees to allow escape of the parasites. The first year ants and other insects destroyed some of the eggs, so last summer a method of enclosure in paper bags was devised. It is estimated that by this means 90 to 98 per cent of the eggs mailed, hatched into the "flies" and escaped into the orchard.

Recommend Control for Mexican Bean Beetle

In studies concluded last summer, Station entomologists determined the best means of controlling the Mexican bean beetle in Connecticut. This is the newest pest of garden beans, as well as the most voracious and the quickest in destruction of any in this state. It damages by defoliating the plants and has injured fields all over the state.

It was found that bean beetle damage could be prevented by spraying or dusting combined with certain cultural practices. Spraying was more effective. The formula recommended is:

Magnesium arsenate	3 lbs.
Casein lime	2 lbs.
Water	100 gals.

Two generations of the beetle occur in a year and both larvae and adults feed on the plants. Larvae of the first generation

hatch and begin feeding soon after the middle of June. It was found that the spray to be effective must be applied before the larvae appear, not after.

The Station has issued a Bulletin on the bean beetle, which is available to all residents of the State.

European Corn Borer Increase Great

Surveys and scouting for the European corn borer last summer revealed that the pest has not only penetrated into every section of the state, but also that the increase in number was tremendous. In some sections, the corn crop was injured. In the southeastern corner of Connecticut, where the borer first entered the state, every fourth cornstalk was infested with at least one larva, and frequently several. The town of East Lyme averaged 8 borers in each infested plant.

New London County has the worst general infestation in the state. In 1928 the first survey was made, and 6 borers were found for every 100 stalks of corn. Last summer this figure had jumped to an average of 80 corn borers for each 100 stalks. The heaviest field infestation was 523 borers to the 100, which occurred in the town of New London.

A survey of 6 towns in southern Middlesex County (East Haddam, Essex, Clinton, Old Saybrook, Saybrook, and Westbrook) showed an average of more than 92 borers in every 100 cornstalks. Windham County last summer had 24 borers to every 100 plants, compared to less than 1 borer to the 100, three years ago.

Backyard gardens in cities and towns were even more heavily infested than the fields. Sweet corn in Groton's home gardens was 88 per cent infested with the corn borer, and New London's backyard gardens were 84 per cent affected. The number of borers for every 100 cornstalks was 831 and 648, respectively.

Mosquito Control Extended

Connecticut's most popular summer resort region, the shore of Long Island Sound, will soon be as free of mosquitoes as men can make it, if the present rate of progress continues. More than 1,000 acres of salt marshes, which breed a particularly obnoxious species of mosquito, were ditched last year under the supervision of the Station. These were in Stonington, which completed in 1931 all the ditching required, Saybrook and Old Lyme. West Haven installed a 30-inch cast iron culvert outlet, with a tide gate. This will permit drainage of a sewage-polluted area that has long been a problem.

It is believed that with the progress made in the control of salt marsh mosquitoes, attention must be directed to the elimination of fresh water species. The salt marsh land may be drained fairly easily, and in fact no serious problem exists in the elimination of salt marsh breeding places in Connecticut. In fresh water work, the problem is most complex, for no one method of treatment can be applied to all situations.

FIGURE 36. Mosquito breeding pools in an undrained marsh.

Asiatic Beetle in New Territory

The Asiatic beetle has selected another fine residential section of New Haven for its latest outbreak. Last summer the grass of a lawn on St. Ronan Street was destroyed, which means that at least 200 beetles to the square yard were present, and that other lawns nearby are likely to be infested. The beetle has also been found on Loomis Place and Autumn Street, in the same part of the city.

A district that included parts of West Haven and Westville, New Haven, is now under quarantine. The beetle has inflicted severe injury to lawns there, and is still present in large numbers. The insect damages the lawn by eating the grass roots. Injury can be stopped by the application of 3 pounds of arsenate of lead (in water suspension, usually 9 gallons) for each 100 square feet of lawn.

Give Aid on Insect Control

Entomologists of the Station identified 625 specimens of insects for farmers, gardeners, and home-owners who asked for this information. Personal service was also extended in 169 visits to orchards, farms, and gardens to advise on the control of insect pests.

The state is covered every year in a survey of the insects that are damaging fruit, vegetables, tobacco, other crops, and shade and forest trees. This summer the apple leaf roller, a pest injurious in New York, caused commercial damage for the first time in Connecticut. The elm beetle was more destructive than in many years, and much injury occurred in the southern part of the state.

Identification of insects is made with the aid of the Station collection, which contains 6,300 species and varieties. Most of these are insects that occur in Connecticut. The specimens are kept in boxes that are air-tight, dust proof and pest proof, and are arranged according to order and family, so that they are easily available for reference.

Four New Towns Infested by Japanese Beetle

The Japanese beetle spread last summer to four towns where it was never found before—Ridgefield, Saybrook, Norwich, and Torrington. These infestations added to those of longer standing, make the beetle present in all parts of Connecticut.

The Ridgefield infestation, where the beetles were so thick they could be seen flying above rose bushes and other plants, resulted from infested turf brought in from New Jersey in violation of the Federal quarantine. Larvae were present in the sod among the grass roots. Five men were fined in Federal court for the offense.

Traps to catch the beetles were placed in Hartford, Willimantic, New London, Meriden, Groton, and Enfield. Lawn areas in Hartford, New London, and Willimantic, were extensively treated with arsenate of lead.

Increase in Number of Nurseries Continues

The second year of the general business depression saw a continued increase in the number of nurseries in Connecticut. In 1931 the Station inspected and granted certificates to 25 new firms, which made a total of 327. This is almost three and one-half times the number 10 years ago.

Many factors are believed to contribute to the spread of the nursery business. It may be that this occupation is entered into by

persons who had moved away from the soil, but who have returned in the "back-to-the-land" tendency of recent years.

Probably the nursery business is made attractive by the fact that it is now more fashionable than formerly to plant gardens and that certain areas of the state are fast being selected as home sites, either for permanent or summer use. Moreover, the automobile has made possible a wider distribution of population and at the same time is partly responsible for the pride of the owner in improving the appearance of his property.

The Station inspectors carefully examine the plants and trees for insect pests and fungus diseases. Any infested plants must be destroyed before a certificate permitting shipment will be issued.

Gipsy Moth Threatens New Territory

A large infestation of the gipsy moth was discovered scattered through the town of Canton. There were 13 separate infestations, which contained a total of 1,162 egg clusters. Scouts in search of the moth covered 1,250 acres of woodland and 73 miles of roadside. The danger of the situation is that an easterly wind at the right time could blow the larvae westward into uninfested territory. The young larva is equipped with aerostatic hairs that enable it to ride on the wind. When in sufficient numbers, the pest completely defoliates trees, but up to the present injury has been prevented.

Large increases of the moth occurred in Granby, and in Wethersfield, where 4,213 egg clusters were found in a single infestation in tall timber on the Connecticut River.

The insect apparently did not spread out of territory already infested, and except in Canton and Granby there seemed to be no increase west of the Connecticut River. Scouting east of the river was incomplete and exact conditions could not be determined. Funds are not available to cover each infested town every year, so the scouting is rotated according to the need.

Thirty-eight tons of lead arsenate were used in spraying the infestations throughout Connecticut, and 3,700 egg clusters were creosoted.

Bee Disease Reduced

Bees in Connecticut in 1931 were freer of the disease known as European foul brood than at any other time since the records have been kept. The number of American foul brood was also reduced. Furthermore, these figures were obtained in the widest inspection the Station has ever been able to make. Funds are not available for a complete inspection every year. Almost 10,700 colonies were inspected last summer.

Honey in Connecticut was estimated to yield a gross income of $29,000 in 1930. This is the latest date for which figures are available.

Pine Shoot Moth Present Throughout State

The Station discovered last summer that the European pine shoot moth was much more widespread in red pine plantations throughout the state than had been realized. Fairfield County in particular was threatened with heavy losses, but the insect was present also in other parts of the state.

FIGURE 37. Red pine shoots injured by European pine shoot moth.

As soon as the seriousness of the pine shoot moth infestation became known, efforts were concentrated to learn the extent and abundance of infestation, to study the life history of the insect, and to perfect control measures. A crew composed of both foresters and entomologists was organized to visit red pine plantations and investigate conditions. Experimental plots were established in Bethany, Branford, Hamden, Woodbury, Middlebury, Saltonstall, and Meriden.

The pine shoot moth injures the pine by killing the buds and boring a short distance into the shoot. One larva may kill several

buds in a cluster during the feeding period. The growth of trees may be permanently arrested, and in some instances the trunk of the tree distorted. The red pine is particularly susceptible. Other species that are attacked are Austrian, Scotch, and Mugho pine.

In view of the fact that the pine shoot moth may become more abundant from year to year, and that young trees seem particularly liable to be injured, growers are advised to undertake control measures as soon as the insect is found. Pruning is the best method of control known at present, and it should be an annual procedure.

The Station believes that if red pine plantations are inspected annually while young, and control measures are followed, there seems to be no reason at present why the trees cannot be protected against serious injury. This is also true of ornamental pines, which are as susceptible as forest plantings.

Re-Eradication Needed in Blister Rust Control

Years of effort to control the white pine blister rust demonstrate the fact that the initial eradication of currant and gooseberry bushes will not afford protection to the pine long enough to bring the trees to maturity. One or more re-eradications will be necessary at intervals of from 5 to 8 years. These bushes are the alternate hosts of the fungus, and it is through them only that the rust can infect the pine. It cannot spread directly from pine to pine.

Such re-eradication is made necessary by the re-establishment of the bushes (known scientifically as Ribes), through the scattering of seed by birds, root sprouting, and development of small seedlings missed in the original eradication. One or two re-eradications will usually insure protection until the pine foliage closes overhead and so shades the ground that Ribes cannot survive underneath. Thereafter attention need be given only to an adequate protective zone surrounding the trees.

Last summer approximately 85,000 wild and 8,500 cultivated bushes were destroyed, principally in the town of Salisbury, which lies in the natural white pine area of northern Connecticut. More than 4,500 acres were covered. Of these, three-fourths were re-eradicated, and on the rest the bushes were pulled for the first time.

The towns of Salisbury, North Canaan, Norfolk, Colebrook, Cornwall, Woodstock, and Thompson are designated "control areas," in which cultivated currants and gooseberries within infecting distance of pine may be destroyed whether they are diseased or not. The Station expects to make other towns control areas when this becomes necessary.

A systematic inspection of all property in three towns was carried out in conjunction with the cultivated Ribes survey and all European black currants were destroyed. This species is so virulent

in infecting white pine that the possession of it was made illegal in Connecticut.

A new nursery control area was established surrounding the state forest nursery at the People's Forest, Barkhamsted. This brings the total number of nursery sanitation zones to 11. These are intended to insure the rearing and distribution of disease-free planting stock. In addition to the figures for Ribes previously mentioned, 4,632 wild and 255 cultivated bushes were removed from 17,664 acres of nursery sanitation zones.

Forest Planting Stock Provided

This year the Station distributed 1,427,000 trees to land-owners throughout the state. About 400,000 of these went to farmers, and 360,000 were seedlings that will be grown as transplants in the nurseries of water companies and owners of large land holdings. The trees were mostly red and white pine, but there were also white and Norway spruce, Douglas fir, and arbor vitae.

The Station is growing more than a million transplants on land adjoining the Tobacco Substation in Windsor, and some are being produced in cooperation with the Connecticut Agricultural College, Storrs.

Through this large scale production, the Station is able to offer trees at a low price as an inducement to reforest idle land.

New Whipple's Yellow Developed

A new Whipple's Yellow sweet corn that seems to combine the best qualities of this popular variety, and eliminate most of the undesirable ones, will be sent out for trial under farm conditions next summer in different parts of Connecticut. In the Station fields, it has shown good size of ear, bright color, and regular rows, together with uniform production from every stalk, and evenness in size, shape and time of ripening.

The corn to be tested by farmers was produced by crossing selections made out of 100 inbred strains of Whipple's Yellow. Improvement of this variety was begun several years ago in response to a request of the Connecticut Vegetable Growers Association. Market gardeners of the state wished more evenness in ripening and greater uniformity as to number of rows.

Spanish Gold Popular

Seed for Spanish Gold, an extra early yellow sweet corn of good quality was sold last summer for the first time and widely planted in Connecticut and other states. It attracted much attention, not only because of its earliness, but also for its excellent

growth and productivity. Spanish Gold is a cross of several varieties, chief of which are an early Spanish flint known as "Cinquantino" and Alpha, an early white sweet corn. Seed may be obtained from a number of seedsmen.

Redgreen Appears as Market Sweet Corn

Redgreen sweet corn, originally developed by inbreeding and crossing as a milky white corn of good quality for canning, proved

FIGURE 38. Hybrid of Whipple's Yellow sweet corn produced on Station Farm.

so satisfactory that it was next desired to be sold for corn-on-the-cob. Last summer market gardeners raised it in addition to canners who planted hundreds of acres in New York and other states.

Redgreen was observed this summer to be somewhat immune to the corn ear worm. In the last few years this insect has multiplied in Connecticut and damaged many crops by burrowing in the tips of the ears. Redgreen has husks that are long and tightly fitted about the tips, so that the worms cannot easily penetrate. Whether the reduced injury is due to this or to difference in time of ripening, cannot definitely be stated from the observations

of last summer. This important point will be more thoroughly investigated.

The Station will send seed for testing to different parts of the state.

Canada-Leaming Fulfills Promise

Canada-Leaming corn was grown last summer in all of the New England states. To farmers in regions where the growing season is short, it fills a long-felt want for an early corn that will produce a large stalk with ripe, or nearly ripe, ears. Planted as late as June 26, Canada-Leaming produced a heavy growth of fodder by September 10. When planted at the regular time, from May 15 to June 1, it produced well-developed ears in most of the plantings, which matured at least to the dough stage by the middle of September. In Penobscot County, Maine, Canada-Leaming ripened in 95 days, reached 9 feet high, and produced big, fat ears from seed grown in Connecticut.

Test Large Southern Corn

For the last two years a large number of late-maturing southern varieties of ensilage corn were tested at the Mount Carmel farm. The plan is to select material for developing a large, late corn particularly adapted to Connecticut. Most of them have not been tried before in this state and some of them, like Cocke's Prolific and Pamunky, make extremely large growth. Although some farmers prefer rather mature silage, others plant late varieties like Eureka or Mastodon, which ordinarily do not reach the dough stage in New England and New York. An extensive series of experiments, conducted jointly with the Storrs Agricultural Experiment Station, demonstrated that a larger acre yield of dry matter usually is obtained from the very late varieties. Later feeding trials at the Storrs Station indicate that the dry matter in immature silage corn has the same feeding value as that in mature silage. Therefore, on farms where tillable land is at a premium and the price of milk is relatively high, the very late varieties may be more economical than such varieties as Canada-Leaming, Sweepstakes, or Burr-Leaming. But which of the many late varieties available should be chosen? Also is there a certain stage of development that corn must reach in order to produce the most dry matter? Several years testing will be necessary to answer these questions.

Value of Big Kernels for Seed

Is there an advantage in using large-kernelled seed corn? Many Connecticut farmers prefer this to small seed varieties, even though the larger kind sometimes sells at a premium and in any case requires more quarts to plant an acre. To test the relative merits, an equal number of kernels of Cocke's Prolific (late small-kernelled) and Pamunky (late large-kernelled developed from Eureka) were planted May 7. The former germinated 75 per cent in the field and the latter 69 per cent. Here the difference was in favor of the small kernels, but the weight of the large-kernel seedlings was much greater. When the seedlings were five inches high and had consumed all the food stored in the seed, the plants were cut and weighed. The weight per thousand of Cocke's Prolific was 13.6 pounds and for Pamunky 16.9. The larger seedlings do not appear different in the field, but because of their stockier growth may withstand adverse conditions and get ahead of the weeds. Since the production at the end of the season was the same there seems to be no other way to justify the preference for large seeded corn.

Test Adaptability of Vegetable Seed

Many varieties and strains of vegetables offered by seedsmen to market gardeners in Connecticut were tested for their adaptability to the soil and climatic conditions of this state, and breeding studies were continued on peppers, spinach, lettuce, beets, carrots, squash, and tomatoes. The trials were made at both Mount Carmel and the new field in Windsor.

In 1931 strains of head lettuce of the New York type were extensively compared and some sold to the Connecticut market gardeners were found wholly unadapted to New England conditions. Of the 18 lots tested, four failed to produce a single marketable head. The others varied from 13 to 54 per cent.

Since carrots of the same variety differ markedly in shape, experiments are in progress that will attempt to find some way of obtaining uniformity in this and other root crops. Some seedsmen have succeeded in producing Chantenay carrots that are practically 100 per cent true to the Chantenay shape of root. Under exactly the same conditions other strains of this variety have all of their roots of the Danvers type. Equal differences are shown in inside and outside color. The carrot presents difficulties to the plant breeder. The structure of the flower and the method of fertilization are such that it is difficult to control pollination so as to

obtain a greater fixity of type. The seed does not develop properly when self-pollinated and there is a marked reduction in size following such inbreeding.

Two lots of eggplant developed in Japan by hybridization were found to be remarkably early, heavy-bearing, and of good quality. They were ready to pick when New York and Black Beauty had set only a few and they bore from 4 to 6 more fruits on each plant, but the Japanese fruit was not as large as the others.

FIGURE 39. Pepper of Sweet Spanish type bred on Station Farm.

Spinach Varieties Compared

Several strains of regular and long-standing Savoy spinach and a few of the smoother leaved types were compared on the Windsor field. All of the regular Savoy made about the same amount of growth, and in color, curliness of leaf, and uniformity were about equal. The Connecticut Station Savoy made the fastest growth, but it also varied the most and produced so many seed stalks that it cannot yet be recommended. Attempts are being made to correct these faults.

The long standing Savoy grew somewhat slower than the other, the leaves were darker green and more curly, and the plants were remarkably uniform in type and entirely free from seed stalks.

Berry Breeding

In 1931 there were 8,000 crosses of strawberry plants growing on the Station farm in Mount Carmel for study and comparison. These were combinations of self-fertilized strains of three standard varieties, Howard 17, Glen Mary and Chesapeake, and some were remarkable for their production, size and quality. The best will be selected for further study in the attempt to obtain strawberries better adapted to Connecticut soil and market requirements. The present need in Connecticut is for later varieties than are commonly grown. The very popular Howard 17 is so early that it comes into competition with berries from New Jersey and Delaware.

Breeding studies are being conducted on raspberries by the same methods utilized on the strawberry plants,—inbreeding and crossing. Some hybrids of excellent characteristics have been fruited.

Discovery Clarifies Point in Evolution

A biological phenomenon that marks a point of progress in evolution has been discovered. It shows a place in the history of species where the change to separate the male and female organisms may have begun, and reveals something about the combination of cells that determine sex in the individual.

These changes and combinations were observed in the development of a certain abnormal corn, which is distinguished by a transference of sex functions, in that one plant bears male organs only and another, female. The scientific descriptive term for this mode of reproduction is "dioecious." Normal corn is one of the majority of seed-bearing plants, that, in contrast to the higher animals, have both sexes in one individual. Pollen from the tassel on top fertilizes the seeds on the ears below.

This dioecious maize, unique as it is, is not a sporadic variation, for it possesses the quality of reproducing itself, thus showing its obedience to the laws of genetics that govern all other species.

Certain other plants, both domesticated and wild, are dioecious, among them bittersweet, asparagus, the cottonwood trees, mistletoe, holly, the date palm, and others. Ages ago in the natural course of evolution their sex functions grew into the form known today. The difference in the story of the new maize is that it was produced under laboratory conditions and the changes that came in it were minutely observed, whereas the changes in the other plants came about unseen.

The dioecious corn was derived from two one-sexed freaks that grew among the normal corn on the Experiment farm in Mount Carmel. One was a male plant that produced pollen and no seed. The other was a female plant, somewhat similar in appearance to milo maize. It bore seed both on the ear and in the tassel and produced no pollen. In a study of inheritance these two plants were crossed and in succeeding generations, after much selecting and testing, appeared the dioecious corn that breeds true.

Fertilizer Experiments with Dahlias

The dahlia may be made to bear broader, richer blossoms and yield more of them, if fed certain stimulating plant foods, it is indicated in a study begun last summer. Experiments with zinnias gave less notable results. They confirmed what is generally stated—that zinnias are hardy plants and easy to raise. They grew well under poor soil conditions at the Mount Carmel farm.

The Jane Cowl, a variety of delicate peach-pink coloring and sturdy characteristics, was selected for the dahlia tests. When fed a "complete" diet of nitrogen, phosphorus and potassium, and limed, a single plant produced as many as two and a fourth dozen blossoms that averaged almost seven inches in diameter. Some dahlias were eight inches across, and in spite of their weight, were held upright on good strong stems.

Nitrogen was the most important fertilizer ingredient. Where this was omitted in an otherwise full treatment, the yield was greatly cut. Phosphorus was also relatively important in comparison to potash on the soil used in this investigation. The dahlia seems to possess powers of obtaining the natural potash in this soil and the potash treatment seemed to be the least necessary. It was indicated that lime is beneficial if the soil is strongly acid.

Dahlia growing has greatly increased in Connecticut in the last few years. Many raise the flower commercially and thousands were sold last summer. Home owners in large numbers are beautifying their grounds. The dahlia study was undertaken to obtain information of benefit to all growers, both amateur and professional. Stable manure and ground bone have always been the standard recommendations for flowers, but manure is no longer available, and there is no adequate knowledge of the fertilizer requirements of ornamentals.

Inventory of Connecticut Soils

Although a detailed soil map of the entire state has not yet been completed because of lack of funds and an adequate base map, the last year has seen material progress. In cooperation with the Storrs experiment station, soil maps have been made of 2,500

farms located in 13 towns of eastern Connecticut. With this information and that accumulated in previous years, a fairly accurate soil map of each of these 13 towns has been made. The immediate objective is to provide a basis for classifying farms into types as a part of the studies in agricultural economics, but at the same time we are adding to our knowledge of the distribution of the soil types already known to exist within the state.

FIGURE 40. Good growth and flower production of dahlia given complete fertilizer treatment.

Lysimeters Show Top-dressing Necessary

A top-dressing of nitrogen applied after heavy rains in May and June showed marked benefit to spinach, onions, carrots, and beets planted on the experiment field in Windsor. Serious crop losses are frequently experienced through the leaching of the

available forms of nitrogen from the soil, particularly with early, shallow-rooted vegetables on sandy soils in the wet weather of spring and early summer.

In the last three years the lysimeter at Windsor has given valuable information on leaching. Records taken this year showed that practically half of the rainfall in May and June washed through the surface soil and carried away almost all of the nitrate nitrogen.

The lysimeter, which is built partly underground, with tubes that lead from tanks of soil treated with various fertilizer applications, collects water passing through the soil. Chemists analyze the liquid to determine the plant food that is thus carried away from the roots. Tests now in progress deal with tobacco.

The amount of leaching is considerably influenced by the character of the soil if the heavy rainfalls are separated by long intervals of dry weather. Fine loam permits less percolation than the sandy soils. The growth of the crop also makes a difference. Leaching within two or three weeks of the time of application of fertilizer causes a loss of only a very small part of the nitrogen that was applied in the organic or ammonium form. On the other hand, leachings in the early part of the season do not take the non-nitrified nitrogen reserve, but they leave the soil temporarily depleted of nitrates. Yellowing of the foliage of shallow-rooted crops may be expected then unless a top-dressing of nitrate nitrogen is applied.

Enlarge Scope of Leaching Studies

The installation of an additional 24 soil tanks 30 inches deep enlarged the scope of the information that may be obtained from the lysimeters, and marked the beginning of two new experiments. This makes a total of 92 tanks.

One is concerned with a means of saving the costly fertilizer that is leached from the soil by rains. With the lysimeter both the amount of fertilizer that passes through the soil and the amount taken up by the plant, can be measured and analyzed exactly. The apparatus has already shown that fall and spring rains wash more nitrogen out of the soil than was used by the plant the previous summer where no cover crop was grown with the usual fertilization system. In this experiment cover crops were planted following tobacco to determine their value in conserving some of the fertilizer applied for one tobacco crop until it is needed for the next. The cover crop takes up considerable nitrogen and other plant nutrients and holds them for a time against leaching.

Both organic and inorganic sources of nitrogen will be investigated, with rye, oats, and timothy as cover crops, and comparison will be made with soil that remains bare between crops.

Another new experiment is a study of the practicability of supplying the crop with available nitrogen at different times during the season in amounts proportional to the immediate needs of the plant. It is known that the tobacco plant makes it greatest growth, and therefore needs food most, in about the fifth and sixth weeks in the field.

If fertilizer can be applied as needed, the amounts may be materially reduced, and loss of plant food by rains washing through the soil will be at least partially eliminated. This scheme for systematically feeding the crop is being studied both in the lysimeter tanks and in a series of concrete walled pits filled with thoroughly mixed soils of two different types, one a light sandy soil and the other a heavier loam.

New Greenhouse Soil Test

A unique method for pot cultures has been developed in a general study of the technique of greenhouse soil tests. Each year a considerable number of the important soil types of Connecticut are subjected to critical examination in the greenhouse and chemical laboratory. According to the new method, the soils are thoroughly leached with water after a test crop is grown on a given series of pots, and the extract removed by suction. Chemical examination of these extracts is furnishing new information as to the nutrients removed by the crop, the amount remaining after the crop is grown, the soil reaction, toxic substances, and the like. With these data it is possible to interpret with greater accuracy the observations made on the plants growing in the pots. This new technique illustrates a phase of investigation that is absolutely essential if we are to develop the best methods of fertilization for the highly specialized crops grown on Connecticut farms.

The method developed by Mitscherlich, of Koenigsburg, Germany, which involves the use of soil diluted with sand, was tried and found unsatisfactory for soils and crops of this state. Certain modifications are planned for study next year.

Vegetable Fertilization

Forty tons of manure were required to exceed the effectiveness of a good commercial fertilizer formula, it was demonstrated in the vegetable trials, which were continued this summer on the Windsor field. Nineteen vegetable crops commonly produced in this state were planted in long rows with 10 different fertilizer treatments in duplicate applied at right angles. The standard, against which all others were compared, was 2,000 pounds an acre of 6-6-8. Part of the nitrogen was in organic materials. The

low phosphorus content was due to the fact that this particular field is high in available phosphorus, which was revealed by a diagnostic field test.

The results, which represent an average of all crops, were

FIGURE 41. Washing and draining of greenhouse pot cultures.

rated on the basis of the standard as 100. A few striking ones were as follows:

Standard	100
40 tons manure	112
Standard plus 20 tons manure	125
Nitrogen side-dressing	108
Standard plus potash	95
Concentrated formula	104
One-half standard	85

On the very early crops, the concentrated formula scored 138 for lettuce, and 112 for spinach. One half standard yielded 85 as an average of the short season crops, and 109 on the long season.

New Soil Tests Devised

New tests have been devised that will enable men in the field to analyze soil simply and quickly as to phosphorus availability, nitrate nitrogen, ammonia nitrogen, active aluminum, and replaceable calcium. The tests involve the use of the Morgan Soil Test Block. Detailed directions for conducting them are given in a Station Bulletin.

The new tests follow a technique similar to a test for soil reaction previously developed at the Station. This method has been widely used, and has been important in answering such practical questions as when to lime for tobacco, alfalfa, or vegetables.

Study New England Forest Soil

The results of three years' study of some typical New England forest soils, are being summarized and will soon be published in bulletin form. It will reveal much about their physical, chemical, and biological characteristics.

Indications are that stands such as scarlet and chestnut oak, which almost invariably produce a felty, slowly decomposing humus layer, are generally found on the poorer soils, such as Gloucester or Merrimac. Soils richer in the mineral bases and more plentifully supplied with moisture were found to produce the better type of hardwoods, which consist of such species as white oak, red oak, hard maple, white ash, hickory and others. The litter in such a stand decomposes rapidly with little or no accumulation.

These laboratory and field studies have yielded much information of value to scientists who are seeking to understand the relationship between the forest and the soil.

Critical Growing Period of Tobacco

Measurements in the last three years show that the critical growing period of the tobacco crop is in mid-July. At this time, the plant adds weight at a phenomenal rate, and weather conditions have their greatest influence. This summer, the crop on the Station farm made half its final growth in one week. On July 27, it weighed three and two-thirds times as much as it did on July 20. If the two weeks July 13-27 are reckoned together, the result is almost as startling. During these 14 days the crop increased its size more than eight times and attained two-thirds of its final growth. The tobacco this year grew extremely slowly the first month, which made the period of greatest growth later than usual. These figures emphasize the importance of studying changes in the soil during this period.

Rootrot Resistant Havana Seed Tobacco

Strains of black rootrot resistant Havana seed tobacco have been developed that are similar in yield and grade to Havana seed commonly grown. Some of the resistant strains are quite promising, but they will be tested further before they are offered to the growers. Tobacco that is not susceptible is the best solution of the black rootrot problem, since many tobacco soils need lime, and lime promotes the disease. The project is carried on in cooperation with the United States Department of Agriculture.

Test Insecticides for Tobacco Insects

Insecticide studies were continued to find a control for the Eastern wireworm, which causes considerable loss to tobacco growers of the Connecticut Valley. Many materials have been used in an attempt to find something that would kill or repel the worms and yet not damage the young plants.

In a survey of tobacco insects, the potato flea beetle was found on every tobacco field visited. It is probably next to wireworms in economic importance. Studies have been instituted to observe the life history of the potato flea beetle on tobacco and to find an insecticide that will control it without leaving a residue on the tobacco leaf.

The tarnished plant bug is becoming increasingly important among tobacco pests and plans are being made to study it fully. This insect caused much injury to tobacco in the New Milford district.

Curing Experiments in 1931

Experiments on the curing of tobacco, under controlled conditions of temperature and humidity, were continued in the curing chambers of the Substation at Windsor. It was found that a temperature of 90° F., with the humidity maintained constantly at 70 to 75 per cent, better tobacco was produced from the first and second pickings than alternations of humidity with a mean of 80 to 85 per cent, or than a constant humidity of 90 to 95 per cent. On third or fourth pickings the alternate humidity was as good as the constant. Alternations of humidity produced a more uniform color distribution on the cured leaf, but not on the sweated leaf. Constant high humidity offered ideal conditions for the growth of the organisms that cause "pole sweat."

Potash and Tobacco

Two important roles that potassium performs in tobacco have been demonstrated in long-continued studies of this element, which have been concluded recently. In the cured leaves it promotes the

incandescent type of combustion required for cigars, and also the intake of moisture that makes the leaf soft and suitable for handling.

In comparison with other crops, tobacco feeds heavily on potassium. The plant draws on this element in large amounts at certain periods. In the fifth and seventh weeks of growth, slightly more than three-fifths of the total potash are absorbed. Absorption is greatest the fifth week, when almost half of the total is obtained. The maximum absorption of potash takes place in the same period that the highest assimilation of nitrogen and the greatest growth occur.

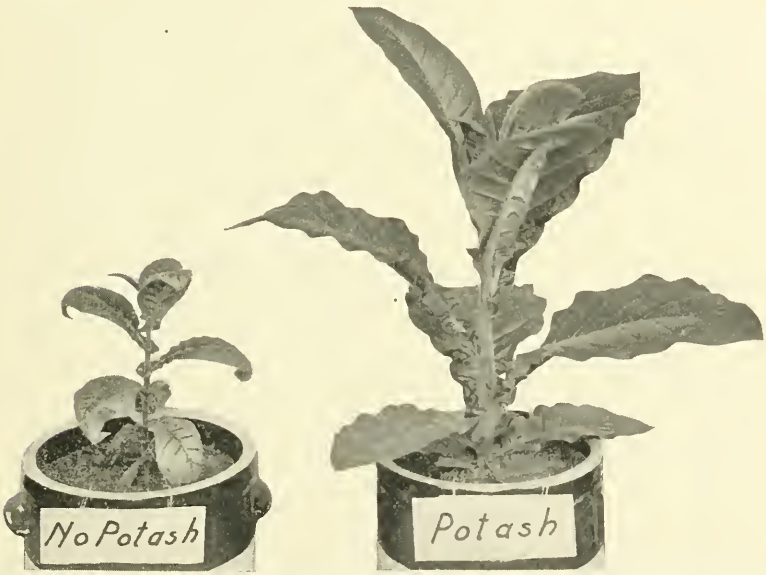

FIGURE 42. Potash deficiency. Large plant on right had all nutrients supplied. Small plant had all nutrients except potash. Plants of same age.

Tobacco that has not had enough potash for its physiological needs shows characteristic starvation symptoms, the most prominent of which are yellow mottling, dead specks, hobbly surface, and downward incurving of margins and tips. Reduction in fertilizer potash affects the quality more than the quantity of the crop. Only at the lowest rate (40 pounds to the acre) was there a reduction in yield and this was not apparent on these plots until after the first year. In quality the leaves with insufficient potash were quite inferior, being harsh, dry, short, and non-elastic.

All of the six carriers tested seemed to be satisfactory for use in a tobacco fertilizer mixture. Sulfate, carbonate, and nitrate of

potash, and sulfate of potash-magnesia, ground tobacco stems and cottonhull ashes were compared on field plots for five years. As far as yield of leaf and percentages of grades were concerned, the differences were slight. Somewhat the best results were obtained with stems, which should be rated at their full value in making up fertilizer formulas. It is recommended, however, that the grower furnish the potash in two or more carriers, rather than one.

Test Tobacco Soil and Seed

Like other branches of the Station, the Tobacco Substation at Windsor has a two-fold purpose. Primarily its objective is to solve, through research, the problems of the tobacco industry, but of equal importance is the direct service rendered to growers. From all parts of Connecticut where tobacco is grown these calls for help come in increasing numbers, touching every phase of the crop from the purchase of fertilizer to the final processing of the leaf.

During the past year more than 2,000 samples of soil from tobacco fields were analyzed, particularly to determine whether lime were needed. Several hundred lots of tobacco seed were cleaned and tested. These two services alone have consumed a large share of the time of one staff member for several weeks, but the value of the information obtained is far greater than its cost. No charge, of course, is made for this service. It is free to all tobacco growers.

Nitrogen in Corn Gluten Meal

Corn gluten meal, hitherto not used as a fertilizer, was compared in a field experiment with other single sources of fertilizer nitrogen. The results were similar to cottonseed and linseed meals. Yield and grade were good but it is yet too soon to draw definite conclusions. If gluten meal proves to be a good carrier of nitrogen for tobacco and can be purchased cheaper than cottonseed meal, another step will be made toward reducing the cost of production.

Jenkins Laboratory in Construction

Funds to build Jenkins Laboratory were appropriated by the General Assembly of 1931, and construction was begun October 26. The building will be on East Rock Road, but it will face the other laboratories, which are on Huntington Street.

Jenkins Laboratory will be devoted to research in four biological sciences, botany, entomology, plant breeding, and forestry, and will provide excellent facilities for experiment and study. It is named for Dr. E. H. Jenkins, who was for 55 years a member of the Station Staff, and for 23 years Director.

The building is long and narrow, 124 by 45 feet, and is set to afford north light in the windows of the laboratories. There are two stories and a basement. For the first time, the department of entomology will have a room for its insect collections and the botany department will have adequate space for the herbarium, which includes a unique collection of economic fungi.

The big, light basement will afford long wished-for facilities. The Oriental peach moth parasite work has previously been carried on in parts of three different buildings. A tier of rooms in the basement will be devoted to this project, three of them air-conditioned, which is necessary for certain phases of this work. Other rooms in the basement will be used for storage, the making of media for cultures, and experiments with fungicides and insecticides.

Moving the four departments to the new building will leave Thaxter Laboratory to be used exclusively by the soils department, and Johnson Laboratory devoted entirely to analytical chemistry and biochemistry.

Governor Speaks at Field Day

Governor Wilbur L. Cross spoke at the annual Field Day August 19 at the Experiment Farm in Mount Carmel. Several hundred persons heard him and visited the Farm.

Fruit pest control was the featured subject of the day. Visitors were invited to come in the morning and see the plots devoted to corn, vegetable, and berry breeding, woodlot management, fertilizer studies, and the control of insect pests and plant diseases.

After lunch, which was eaten at noon under the big tent, a short program was given. Dr. Clinton, Dr. Britton, and Dr. Garman discussed various aspects of fruit pest control.

A demonstration of European corn borer control, both cutting off the stalk close to the ground and turning the whole plant underground, was held after the program.

Tobacco growers were invited to a field day the morning of July 27 at the Tobacco Substation in Windsor. Members of the staff talked on various phases of their work, and the visitors inspected the experiments in fertilization, leaching, insect control, and disease resistant tobacco strains.

A "twilight meeting" was held at Windsor August 5 to give vegetable growers an opportunity to inspect the vegetable fertilization studies, the breeding experiments, and the tests of varieties now offered on the market.

Station Host to Editors

The Connecticut Editorial Association held its annual meeting the afternoon of January 24 at the Station. The Director explained the work of the Station and members of the association were conducted through the laboratories. Afterwards a business meeting was held in the Assembly Hall, and at 7 o'clock, the annual dinner was served at the Faculty Club of Yale University.

On July 11 the Connecticut Beekeepers Association held its fortieth annual summer outing at the Station. There were morning and afternoon sessions and a basket lunch was served on the lawn at noon.

The eighth annual Conference of Entomologists working in Connecticut took place at the Station October 30, and amateur collectors as well as professional entomologists attended. The program included Connecticut speakers and others.

The board of directors of the New Haven County Farm Bureau and other organizations and groups met at the Station during the year.

Dwarf Apple Trees Demonstrated

To demonstrate the possibilities of dwarf apple trees for town planting, the Station is growing several trees of this kind. Many city and town home-owners are prevented from having apple trees, which they desire chiefly for their Spring blossoms and partly for their fruit, by the difficulty of caring for full-sized trees. They must be sprayed at least three or four times a year for protection against insect pests and fungous diseases. The average person does not own the equipment to spray the top of a big tree, and renting it is expensive.

Dwarf trees solve this problem nicely, for they may be sprayed easily with a hand spray gun. Without much effort, town people may grow such trees to enjoy for their beauty in the Spring and their fruit in the Fall.

The Station's dwarf trees were obtained by grafting common varieties onto the roots of Paradise, a full dwarf stock. The result of this treatment is a small tree bearing the kind of apple preferred. Some nurserymen also offer semi-dwarf trees, grafted on Doucin root stocks. If full dwarf trees are desired, Paradise stock should be insisted upon.

New Weather Instruments at Mount Carmel Farm

Instruments with which to study natural phenomena in terms of weather, were installed this summer on the Station Farm, Mount Carmel. The behavior of insects, fungi and plants is greatly influenced by changes in the weather and an exact record of meteorological conditions is essential to careful field experimentation.

FIGURE 43. Dwarf apple tree grown on Station grounds.

The apparatus for measuring wind velocity and counting minutes of sunshine, is mounted on top of the main barn. Three silver-colored half-cups on a shaft revolve with the wind and when a mile of wind passes over them, it is recorded in ink on a disc under the roof. Minutes of sunshine are recorded on the same disc, which is regulated by an electric 8-day clock.

Humidity and temperature are measured and recorded and a rain gauge takes account of rain and snow fall.

Library Kept Up-to-date

Special attention is given to maintaining the library up-to-date, since research workers necessarily must depend largely upon it to keep in touch with the progress made by other scientists. Most of this material is published in scientific journals, reports of proceedings, and bulletins of the United States Department of Agriculture and of experiment stations in this country and abroad. The Station now subscribes to 95 journals and its bound volumes number about 17,400. Last year the total number of volumes and pamphlets received was 6,120.

The Library is notable in having probably the most complete bound set of United States experiment station publications in existence. This is for the most part due to Professor Johnson, the first director, who was particularly zealous in collecting them in the early days when the first stations were organized. This work was continued by Dr. Jenkins and the former librarian, Miss V. E. Cole. Professor Johnson was generous in giving his own books to the Station, so that the Library was in reality founded on his gifts. The late Dr. Thomas B. Osborne left the Station many rare sets of journals and Dr. Jenkins presented a complete set of the Station's own publications bound in leather.

Changes in Staff

Appointments

Neely Turner, M.A., Assistant Entomologist, June 1, 1931.

Projects for 1931-32

Analytical Chemistry

1. Inspection of fertilizers.
2. Inspection of feeding stuffs.
3. Inspection of foods and drugs.
4. Calibration of Babcock glassware and thermometers.
5. Analyses of insecticides and fungicides.
7. Analyses of special and miscellaneous foods.
8. Collaborative studies on analytical methods.

Biochemistry

1. Cell chemistry.
   a. A detailed examination of the nitrogenous constituents of plant cells, in particular those of leaf tissues. The further development of methods for the determination of the different forms of nitrogen in extracts of such tissues.

b. An investigation of the nitrogenous constituents of the tobacco plant with special reference to the changes that occur during curing.
c. An investigation of the composition of tobacco seed.

2. Protein chemistry.
   a. The methods for the determination of the basic amino acids yielded by proteins with the object of increasing their accuracy and convenience.
   b. The methods for the separation of other amino acids yielded by proteins.
   c. The properties of certain of the amino acids and their derivatives.
   d. Methods for the preparation of pure proteins on a large scale with the object of obtaining material for chemical and nutritional study.
   e. Methods for the preparation of the proteins of the tobacco seed.
   f. The properties of the globulin of the tobacco seed.
3. Nutrition investigations.
   a. The relation of diet to the rate of growth with special attention to certain factors that appear to determine rapid growth.
   b. The investigation of the relation of certain constituents of the diet to the growth of skeletal tissue.
   c. The relation of rate of growth to well-being as shown by the investigation of certain organs and tissues.
   d. The relation of the rate at which growth has occurred to the basal metabolism of the rat.
   e. The investigation of the nutritive properties of the tobacco seed.

Botany

2. The nature and cause of mosaic disease of plants.
5. Plant disease survey of Connecticut.
6. Study of the perfect stage of *Thielavia basicola.*
8. Spraying and dusting experiments on apples and peaches. (See also Entomology No. 3.)
15. A study of the virulence of the chestnut blight.
16. Tobacco diseases, especially black and brown rootrot.
20. Diseases of shade trees.
23. Rogueing as a control for raspberry mosaic. (With U. S. Dept. Agr.)
24. Studies of the morphology of the willow scab fungus.
26. Tests of various materials for soil treatment in control of dampening-off of vegetable seedlings.
27. An investigation of an elm disease in Connecticut.
28. Studies on the identification of apple varieties by seed characters.
29. The absorption of nitrogen through the leaves of the plant.
30. Control of diseases of vegetable crops.

Control and Service

12. Seed testing.
25. Determination of the discharge of ascospores of the apple scab.

Entomology

3. Spraying and dusting experiments on apples and peaches. (See also Botany, No. 8.)
9. Insect survey of Connecticut.
17. Studies in the control of the Oriental fruit moth.
18. Life history of the imported currant worm.
20. Further studies of the birch leaf miner, *Fenusa pumila.*
21. Control of the spinach leaf miner.
28. Investigations on oil sprays.
29. Control of the Mexican bean beetle in Connecticut.
30. A study of insects that attack the tobacco plant. See also Tobacco Substation, No. 20.)
31. Studies on the biology and control of the European pine shoot moth. (See also Forestry, No. 13.)

Control and Service

10. Inspection of orchards and nurseries.
11. Control of gipsy moth. (In cooperation with U. S. Dept. Agr.)
12. Elimination of mosquito nuisance.
13. Inspection of apiaries.
19. Control of the European corn borer. (In cooperation with U. S. Dept. Agr.)
24. Control of the Asiatic beetle.
25. Control of the Japanese beetle. (In cooperation with U. S. Dept. Agr.)
27. Rearing and distributing parasites of the Oriental fruit moth.

Forestry

1. Experimental plantations on a sandy tract at Rainbow.
   a. Comparison of many species of conifers and hardwoods, in pure stands and in combinations.
   b. Methods of management for those species that have survived.
   c. Studies on growth and habits of the several species.
2. Effect of thinning in white pine at Shaker Station.
3. Effect of thinning in hardwoods at Quassipaug Lake.
6. Studies of forest plantations throughout the state.
   a. Comparative growth of various species.
   b. Reasons for success or failure.
   c. Soil and other site factors necessary for success of each species.
10. An investigation of the distribution and growth of forest trees as influenced by soil conditions and other site factors.
11. Coniferous seed bed study to determine:
   a. The value of fertilizers in seed beds.
   b. The value of different amounts of seed.
   c. The value of dusts and sprays in preventing dampening off.

12. A study of preservative treatments of native woods.
13. Studies on the biology and control of the European pine shoot moth. (See also Entomology, No. 31.)

Control and Service

5. Distribution of forest planting stock. (Under Clarke-McNary Act.)
7. Control of white pine blister rust. (With U. S. Dept. Agr.)

Genetics (Plant Breeding)

1. A genetic study of hereditary characters in corn involving their linkage relations and variability.
2. The effects of inbreeding and crossing upon corn.
3. Methods for the improvement of naturally cross-fertilized plants by selection in self-fertilized lines, with particular attention to field corn for grain and ensilage; alfalfa; some of the more important vegetable crops, such as sweet corn for market gardening and canning, beets, carrots, cucumbers, melons, squash, and some fruits, such as bush fruits and strawberries.
4. Methods for the improvement of naturally self-fertilized plants, with particular attention to tobacco and vegetable crops such as lettuce, lima beans and tomatoes.
5. A study of variation and the effects of selection in strains of cross-fertilized and self-fertilized vegetables.

Soils

1. A descriptive inventory of Connecticut soil types in relation to their use for crops, pasture and forest.
2. The physical and chemical characteristics of important soil types in relation to the nutritive response of tobacco and other crops when these soils are variously treated in the greenhouse.
3. Nutrient requirements of vegetable crops on important soil types used for market gardening in the state.
4. A study of the physical, chemical and biological conditions of several soil types in natural mixed hardwoods and in planted coniferous forests.
5. Lysimeter studies of the drainage losses and other changes that occur in several soils under heavy fertilization as practiced for tobacco and vegetables.

Tobacco Substation

1. Fertilizer experiments—various sources and rates of nitrogen, phosphoric acid and potash.
2. Field tests with farm manure.
4. Tobacco nutrition studies—the role of nitrogen, sulfur, chlorine, potassium, calcium, manganese, boron and magnesium.

5. Improvement of Havana seed tobacco. (With U. S. Dept. Agr.)
6. Improvement of Broadleaf tobacco.
7. Improvement of Cuban shade tobacco.
8. The effect of various winter cover crops used on tobacco land.
11. Soil reaction in relation to tobacco.
13. Preservative treatment of shade tent poles. (See Forestry, No. 12.)
15. Topping and suckering experiments.
17. The role of humidity and temperature in curing tobacco.
20. A study of insects that attack the tobacco plant. (See also Entomology, No. 30.)

Publications

Bulletins of the Station

Report on Commercial Fertilizers for 1930. E. M. Bailey. No. 321.

Report of the Director, 1930. W. L. Slate. No. 322.

Chemical Investigations of the Tobacco Plant, Part I. Hubert B. Vickery and George W. Pucher. No. 323.

Chemical Investigations of the Tobacco Plant, Part II. Hubert B. Vickery and George W. Pucher. No. 324.

Commercial Feeding Stuffs, Report on Inspection, 1930. E. M. Bailey. No. 325.

Tobacco Substation at Windsor, Report for 1930. P. J. Anderson, T. R. Swanback, O. E. Street and Others. No. 326.

Connecticut State Entomologist, Thirtieth Report. W. E. Britton, Ph.D. No. 327.

The Squash Vine Borer. R. B. Friend. No. 328.

Report on Food and Drug Products. E. M. Bailey. No. 329.

The Relation of Forest Composition and Rate of Growth to Certain Soil Characters. H. W. Hicock, M. F. Morgan, H. J. Lutz, Henry Bull, and H. A. Lunt. No. 330.

Circulars of the Station

Connecticut Laws of Plant Pests, Diseases of Bees, and Mosquito Elimination, January, 1931. W. E. Britton. No. 73.

Japanese Beetle Quarantine. No. 74.

Spanish Gold Sweet Corn. Donald F. Jones and W. Ralph Singleton. No. 75.

European Corn Borer. W. E. Britton. No. 76.

Lawn Fertilization. M. F. Morgan. No. 77.

Satin Moth Quarantine. W. E. Britton. No. 78.

Quarantine Regulations Affecting Shipments of Connecticut Nursery Stock. W. E. Britton. No. 79.

The European Pine Shoot Moth. R. B. Friend. No. 80.

Journal Papers

Vickery, Hubert Bradford, and Pucher, George W. A source of error in the determination of amide nitrogen in plant extracts. Jour. Biol. Chem., **90**: 179-188. 1931.

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Morgan, M. F. Effect of silvicultural practices, forest removal and reforestation upon soil character. Amer. Soil Survey Assoc., **12**: 49. 1931.

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Block, Richard J., and Vickery, Hubert Bradford. The basic amino acids of proteins. A chemical relationship between various keratins. Jour. Biol. Chem., **93**: 113-117. 1931.

Botsford, R. C. New developments in mosquito control in Connecticut during 1930. Proc. 18th Ann. Meeting N. J. Mosquito Extermin. Assoc.: 146. 1931.

Bull, Henry. The use of polymorphic curves in determining site quality in young red pine plantations. Jour. Agr. Research, **43**: 1-28. 1931.

Friend, R. B. The European pine shoot moth in red pine plantations. Jour. Forestry, **29**: 551-556. 1931.

Hicock, Henry W. Pruning in young plantations. Jour. Forestry, **29**: 541-543. 1931.

Jones, Donald F. Dioecious maize. Science, **73**: 432. 1931.

Lunt, Herbert A. The carbon-organic matter factor in forest soil humus. Soil Sci., **32**: 27. 1931.

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